High-Temperature, Wirebondless, Ultra-Compact Wide Bandgap Power Semiconductor Modules for Space Power Systems, Phase I

Completed Technology Project (2010 - 2010)

Project Introduction

Silicon carbide (SiC) and other wide band-gap semiconductors offer great promise of high power rating, high operating temperature, simple thermal management, and ultra-high power density for both space and commercial power electronic systems. However, this great potential is seriously limited by the lack of reliable high temperature device packaging technology. The objective of this proposed research is to develop a ultra-compact, hybrid power module packaging technology based on the use of double leadframes and direct leadframe-to-chip transient liquid phase (TLP) bonding that allows device operation up to 450

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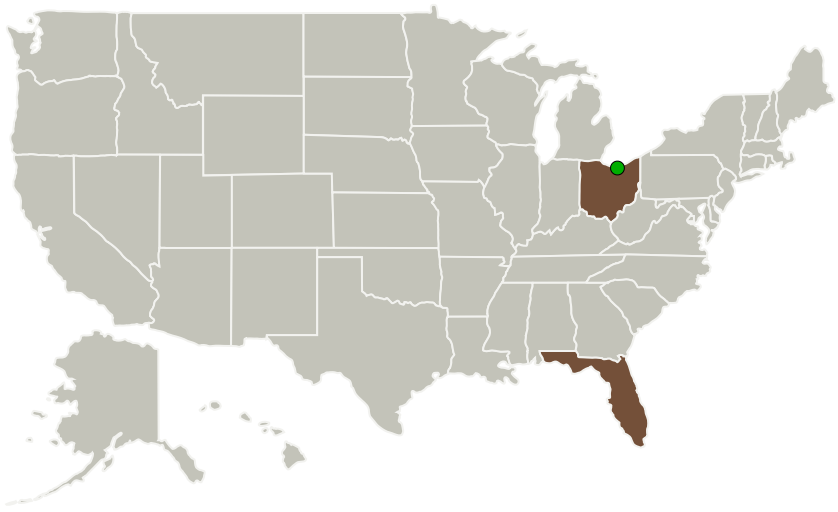
C. The Phase I research plan will include: 1) material selection; 2) electrical, mechanical, and thermal design of a half-bridge prototype module; 3) packaging process development using volume manufacturing processes; 4) stress and thermal modeling and analysis; 5) material characterization under high temperature and high temperature cycling; and 6) cost estimation and comparative analysis with competing technologies. The unique advantages of this innovative solution include very high current carrying capability, low package parasitic impedance, low thermo-mechanical stress at high temperatures, double-side cooling, and modularity for easy system-level integration. The new power module will have a very small form factor with 3-5X reduction in size and weight from the prior art.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
APECOR	Lead Organization	Industry Small Disadvantaged Business (SDB)	Orlando, Florida
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations	
Florida	Ohio

Project Transitions

January 2010: Project Start

July 2010: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140035)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

APECOR

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

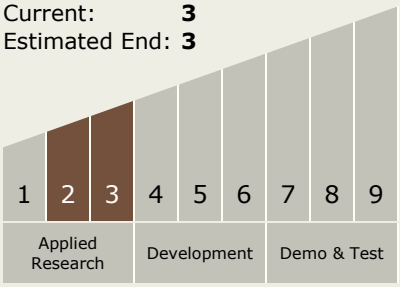
Carlos Torrez

Principal Investigator:

John Elmes

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



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Technology Areas

Primary:

- TX03 Aerospace Power and Energy Storage
  - TX03.1 Power Generation and Energy Conversion
    - TX03.1.2 Heat Sources

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System